Subpolar Atlantic Glider Surveys

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Grant #: N00014-02-1-0791

LONG-TERM GOALS

Our long-term goal is to understand the thermohaline circulation of the high latitude Atlantic Ocean and its role in climate.

OBJECTIVES

The objective of this project is to extend knowledge of deep convection in general and Labrador and Irminger Sea circulation through the regular and deliberate survey of these regions over an annual cycle.

APPROACH

The approach is to use long range autonomous underwater glider vehicles to make regular hydrographic sections across the Labrador and Irminger Seas, including a transatlantic section. Seaglider (Eriksen et al, 2001) and Deepglider (a full ocean depth version of Seaglider now under development) vehicles will be used to make repeated hydrographic surveys across the Labrador Sea year round and to make a transoceanic section from Labrador or Newfoundland to Ireland. These sections will resolve circulation at horizontal scales of a few kilometers.

WORK COMPLETED

Two Seagliders were deployed on 2 October 2003 from a small boat at the continental shelf edge near Nuuk, Greenland. These vehicles are beginning to survey the Labrador Sea autonomously, diving to 1000 m depth about three times daily, transmitting their data at the end of each dive cycle via Iridium, sea conditions permitting.

RESULTS

Both gliders currently deployed in the Labrador Sea have resolved the West Greenland Current and one of the two has crossed through an energetic anticyclone capped by fresh cold water characteristic of that found on the continental shelf. Within this eddy, vertical velocities of up to 6 cm/s were observed throughout the upper 1 km, apparently due to internal waves with frequencies comparable to the inertial frequency. Progress of these gliders can be found at www.seaglider.washington.edu/gina.

Figure 1 Seaglider #004 shortly after launch ~45 nautical miles west of Nuuk, Greenland (accompanied by a pair of northern fulmars) 2 October 2003

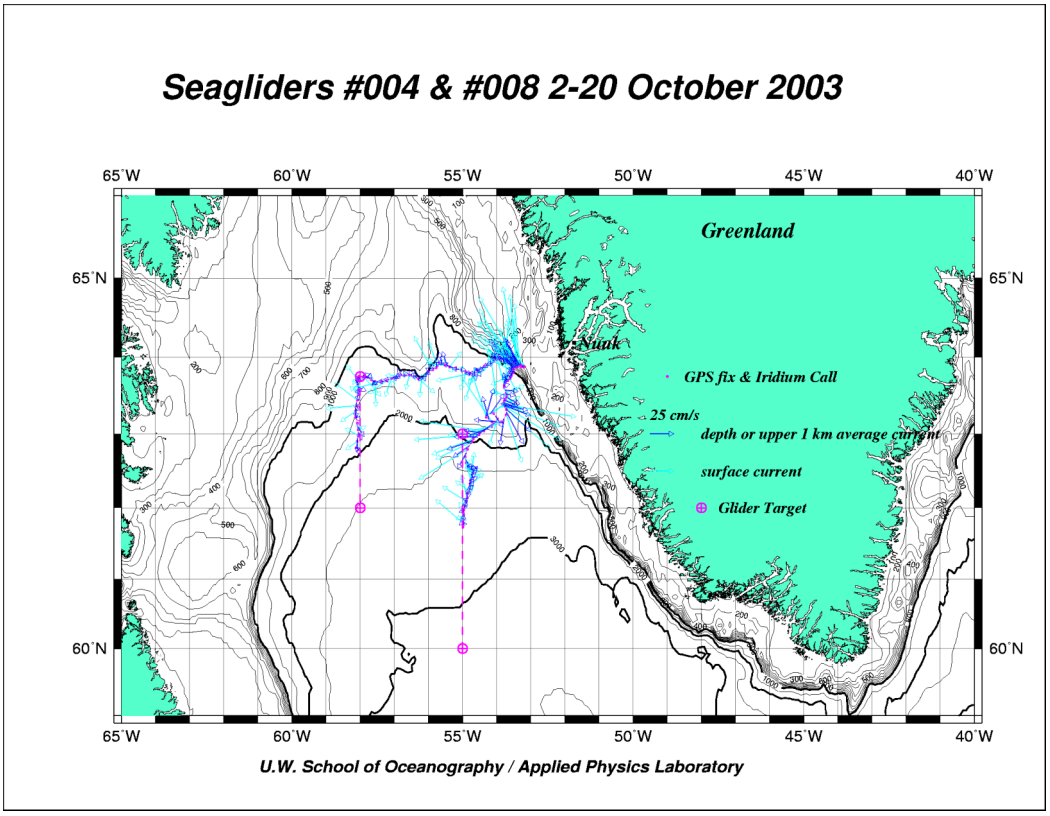

Figure 2. Tracks of 2 Seagliders launched at the continental shelf edge west of Nuuk, Greenland. Blue and cyan arrows indicate 1000m depth averaged and surface currents, respectively. Depth averaged current of an anticyclonic eddy found southwest of the launch site was strong enough to carry Seaglider #008 around it once before continuing its transect.

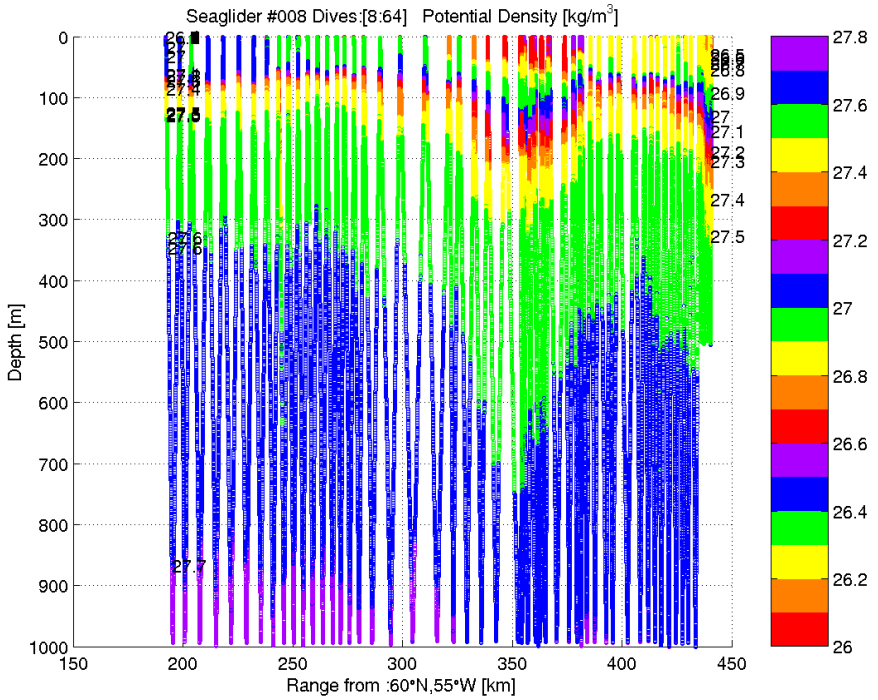

Figure 3. Potential density plotted along the sawtooth track of Seaglider #008 plotted against distance from its target. Isopycnals are seen to deepen by as much as 400m through the anticyclonic eddy. Water found at the sea surface at the eddy core is even lighter than that detected at the shelf edge.

IMPACT/APPLICATIONS

Ship-based hydrographic surveys of the subpolar Atlantic are too expensive to sample the region adequately in space and time to resolve the processes responsible for determining ocean circulation. The use of gliders will make possible fully autonomous open ocean hydrographic surveys of basic oceanographic fields (temperature, salinity, dissolved oxygen, current) at a small fraction of the cost of using ships. Gliders are expected to operate for a year for roughly the cost equivalent of one day of oceanographic research vessel time. They will be able to perform the first ever year-round surveys of high latitude hydrographic structure along a controlled grid. The same technology could be applied to other remote, harsh environment regions of the world ocean.

RELATED PROJECTS

Deep Glider Development (N00014-02-1-0103) – A project to develop an autonomous underwater glider capable of operating at depths as great as 6000m.

REFERENCES

Eriksen, C. C., T. J. Osse, R. D. Light, T. Wen, T. W. Lehman, P. L. Sabin, J. W. Ballard, and A. M. Chiodi (2001) Seaglider: A long range autonomous underwater vehicle for oceanographic research. IEEE J. Oceanic Engineering, 26, 424-436.